RUST GEOTECH INC.

Spectral Gamma-Ray Borehole
Log Data Report

Log Event A

Borehole 60-12-01

Borehole Information

Farm : U
Tank : U-112
Site Number : 299-W18-113
N-Coord : 37,940
W-Coord : 75,817
TOC Elevation : 664.63
Water Level, ft :
Date Drilled : 7/31/1974

Casing Record

Type : Steel-welded
Thickness, in. : 0.280
ID, in. : 6
Top Depth, ft. : 0
Bottom Depth, ft. : 125

Borehole Notes:

This borehole was drilled with 6-in. casing to a depth of approximately 125 ft. The driller initially hit cement at a depth of 6 ft; the hole was moved 3 ft to the south and continued.

According to driller's records, samples were checked periodically with a Geiger Mueller counter while the hole was being drilled. All samples between 50 and 90 ft registered very high count rates on the Geiger Mueller counter. The driller's log infers that somewhat elevated count rates were observed for samples between 90 ft and the bottom of the borehole. The greatest activity was observed between 50 and 70 ft (the count rate exceeded 100,000 cps on the Geiger Mueller counter). Cuttings from this interval were placed in special containers and designated for appropriate disposal.

This borehole is at the base of a berm that covers a transfer line. It appears that when the borehole was started at its original location, the concrete transfer line corridor was encountered, but not penetrated. The zero reference is the top of the casing.

Equipment Information

Logging System : 1
Detector Type : HPGe
Detector Efficiency: 35.0 %
Calibration Date : 03/1995
Calibration Reference : GJPO-HAN-3
Logging Procedure : P-GJPO-1783

Log Run Information

Log Run Number : 1
Log Run Date : 12/7/1995
Logging Engineer: Alan Pearson
Start Depth, ft.: 0.0
Counting Time, sec.: 100
L/R : L
Shield : N
Finish Depth, ft. : 19.0
MSA Interval, ft. : 0.5
Log Speed, ft/min.: n/a

Log Run Number : 2
Log Run Date : 12/7/1995
Logging Engineer: Bob Spatz
Start Depth, ft.: 18.0
Counting Time, sec.: 100
L/R : L
Shield : N
Finish Depth, ft. : 47.0
MSA Interval, ft. : 0.5
Log Speed, ft/min.: n/a

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Log Run Number : 3	**Log Run Date :** 12/8/1995	**Logging Engineer:** Bob Spatz			
Start Depth, ft.: 46.0	**Counting Time, sec.:** 100	**L/R :** R	**Shield :** N		
Finish Depth, ft. : 71.5	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a			

Log Run Number : 4	**Log Run Date :** 12/8/1995	**Logging Engineer:** Bob Spatz	
Start Depth, ft.: 70.5	**Counting Time, sec.:** 100	**L/R :** L	**Shield :** N
Finish Depth, ft. : 79.0	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Log Run Number : 5	**Log Run Date :** 12/8/1995	**Logging Engineer:** Bob Spatz	
Start Depth, ft.: 78.0	**Counting Time, sec.:** 100	**L/R :** L	**Shield :** N
Finish Depth, ft. : 90.0	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Log Run Number : 6	**Log Run Date :** 12/8/1995	**Logging Engineer:** Bob Spatz	
Start Depth, ft.: 125.0	**Counting Time, sec.:** 100	**L/R :** R	**Shield :** N
Finish Depth, ft. : 121.0	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Log Run Number : 7	**Log Run Date :** 12/11/1995	**Logging Engineer:** Bob Spatz	
Start Depth, ft.: 122.0	**Counting Time, sec.:** 100	**L/R :** L	**Shield :** N
Finish Depth, ft. : 97.0	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Log Run Number : 8	**Log Run Date :** 12/8/1995	**Logging Engineer:** Bob Spatz	
Start Depth, ft.: 98.0	**Counting Time, sec.:** 100	**L/R :** R	**Shield :** N
Finish Depth, ft. : 88.0	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Log Run Number : 9	**Log Run Date :** 12/11/1995	**Logging Engineer:** Bob Spatz	
Start Depth, ft.: 40.0	**Counting Time, sec.:** 100	**L/R :** L	**Shield :** N
Finish Depth, ft. : 27.0	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a	

Analysis Information

Analyst : H.D. Mac Lean

Data Processing Reference : P-GJPO-1787 Analysis Date : 7/15/1996

Analysis Notes :

Nine runs were required to log this borehole. The predominant reason for the unusually high number of log intervals and switched back to 100-s live time intervals for the depths of lower radiometric activity.

The pre- and post-field verification spectra indicate that the logging system was generally operating within specifications during data collection, except for a brief period immediately following the start of field operations on each day. The energy/channel drift observed during the logging runs remained within an acceptable range for the search parameters used by the processing software; multiple energy calibrations were not required to process the data.

The monitored portions of the verification spectra indicate no deterioration in the efficiency of the detector after the passage of sufficient warm-up time; however, these spectra indicate that a slight decrease in the detector efficiency (about 10 percent) lasting for one or two hours might occur following the commencement of a day's field operation. Although the repeatability of the system was generally acceptable, as indicated by data overlaps that occurred when the same depth intervals were logged by different log runs, a repeat of a section of the borehole was conducted specifically to demonstrate repeatability. This repeat section revealed the system may not have fully stabilized before some spectra were acquired. Count rates recorded for these early recorded spectra are about 10 percent low. Although the calculated concentrations within the overlapping intervals were within the statistical uncertainty (at the 95-percent confidence level) of the measurements, the repeat log run of the interval from 27 to 40 ft (log run 9) produced calculated Cs-137 (662 keV) and U-238 (609 keV) concentrations that were about 10 to 15 percent higher than those obtained using the log data from the original run. A comparison of the concentration of representative radionuclides (U-238, Cs-137, K-40, and Th-232) is included with the set of logs for this borehole. The calculated concentration of the low-energy gamma-ray emitters (609 keV and 662 keV) is systematically higher using the data from log run 9 compared to that provided by log run 2; the higher energy gamma-ray emitters (1461 keV and 2614 keV) show better repeatability.

The discrepancy in repeatability may have been caused by a problem with the detector high-voltage power supply that has since been corrected. The greater discrepancy in the repeatability of measurements of the concentration of low-energy gamma rays than the higher energy gamma rays is consistent with low detector supply voltage. The energy of the lower energy gamma rays is close to the threshold energy required to initiate the counting process; the count rate for the latter may be unaffected because the energy of these gamma rays is proportionately higher and well above the system's counting threshold.

The causes of the temporary decrease in detector efficiency are described in a nonconformance report (N-96-05, August 1996). The differences in calculated concentration are small, and the number of spectra affected are insignificant. Since the event described above, the logging system (referred to as Gamma 1) has been modified to eliminate the discrepancy in repeatability.

Significant quantities of Cs-137 contamination were encountered. Cs-137 concentrations well above the MDL occurred continuously between the ground surface and the bottom of the borehole. Intervals of higher concentrations occur at about 4, 10, and 17 ft. The measured Cs-137 concentrations at these depth locations were about 2,000, 700, and 30 pCi/g, respectively. Lower values of Cs-137 contamination (between 1 and 9 pCi/g) occur in the interval beween 17 and 50 ft. A highly contaminated zone begins at a depth of about 50 ft. Cs-137 concentrations greater than 2,000 pCi/g occur in the interval between 50 and 68 ft. Even higher concentrations may be encountered in this interval; however, the SGLS could not record data between depths of 49.5 and 67.5 ft because of high dead time.

High concentrations of Cs-137 (more than 2,000 pCi/g) were also indicated in the intervals between depths of 84 and 98 ft and from 121.5 ft to the bottom of the borehole. The Cs-137 concentration could not be calculated in the interval between 84 and 98 ft because high dead time prevented the SGLS from operating in this region. The zone of contamination encountered in the bottom of the borehole was not completely defined; this zone extends to an unknown depth below the bottom of the borehole.

The SGLS log indicates that the intervals between these extremely high contaminated zones are also highly contaminated; calculated concentrations of Cs-137 range between several hundred and several thousand pCi/g. The intensity of the Cs-137 gamma source is great enough to distort the entire spectrum; some error may be introduced into the radionuclide concentration calculations.

Extremely high radiometric activity is not in question. In addition to the high radiometric activity of samples taken during the drilling operation discussed in the "Borehole Notes" section above, the gross gamma-ray log taken in this borehole indicates a high count rate in the 50-ft depth range of this borehole. Tank Farms gross gamma log data and earlier log summaries indicate the zones of Cs-137 contamination discussed here were in place before the borehole was installed.

The casing thickness is presumed to be 0.280 inch (in.), on the basis of published thickness for schedule-40, 6-in. steel casing. Casing-correction factors for a 0.280-in.-thick steel casing were applied during analysis.

Details regarding the interpretation of the data for this borehole are presented in the Tank Summary Data Reports for tanks U-109 and U-112.

Log Plot Notes:

Separate log plots show the man-made (e.g., Cs-137) and the naturally occurring radionuclides (K-40, U-238, and Th-232). The natural radionuclides can be used for lithologic interpretations. The headings of these plots identify the energy peak for the specific gamma rays used to calculate the concentrations.

A combination plot includes the man-made radionuclides, the naturally occurring radionclides, the Total Gamma count derived from the SGLS and the Westinghouse Hanford Company (WHC) Tank Farms gross gamma log. The gross gamma plot displays the latest available digital data from WHC with no attempt to adjust the depths to coincide with the SGLS data.

Uncertainty bars on the plots show the statistical uncertainty for the calculated concentrations at the 95-percent confidence level. The minimum detection level (MDL) is shown by open circles on the plots. The MDL of a radionuclide represents the lowest concentration at which positive identification of a gamma-ray peak is statistically defensible.